SWDIV G2000tg
Pavement Systems Technical Guide

04/02

TECHNICAL GUIDANCE

FOR

CIVIL ENGINEERING DESIGN

OF

PAVEMENT SYSTEMS

Prepared By:

SOUTHWEST DIVISION, NAVAL FACILITIES ENGINEERING COMMAND, SAN DIEGO, CALIFORNIA

SWDIV G2000tg
Pavement Systems Technical Guide

04/02

PART 1 - GENERAL

1. INTENT: The purpose of this document is to provide technical guidance and outline technical requirements for the more typical aspects of the civil design portion of Design-Build contracts for Southwest Division, Naval Facilities Engineering Command. This Technical Guide specifically describes minimum acceptable standards for design and construction of Pavement Systems for Design-Build Projects. The information provided in this guide shall be utilized by civil designers in the development of their portion of the plans, specifications and calculations and shall serve as minimal civil design guidance. This is a guide only and is not intended to cover every situation or restrict innovative design alternatives and good common sense design decisions. Questions or recommendations for improvement of this document should be brought to the attention of SOUTHWESTNAVFACENGCOM.

2. GUIDANCE AND CRITERIA: For further guidance and sources of criteria refer to the latest revision of:

a. The Request for Proposals for the particular D-B contract.

b. The Southwest Division AE Guide - “GUIDE FOR ARCHITECT-ENGINEER FIRMS”.

c. Applicable Design Manuals, Military Handbooks, and various other military publications.

d. Section G2000 Guide Specifications (particularly the guide or criteria notes accompanying the guide specification sections).

e. "Parking Area Criteria For Vehicles" (NAVFAC Drawing Number 1404837).

f. Contact the Activity concerning site-specific issues and user requirements. This contact is particularly important in projects that involve Physical Security applications.

g. Department of Transportation Standard Specifications for Roads and Bridges for the State where the project is located.

i. "General Requirements For Shore Based Airfield Marking And Lighting" (NAVAIR 51-50AAA-2).

PART 2 - PAVEMENT SYSTEMS

1. GENERAL:

1.1 For geometric design of vehicular roads and streets refer to AIR FORCE AMF 88-7 CHAP 5 "GENERAL PROVISIONS AND GEOMETRIC DESIGN FOR ROADS, STREETS, WALKS AND OPEN STORAGE AREAS". For layout of parking lots refer to NAVFAC Definitive Drawing Number 1404837.

1.2 For geometric design of airfield pavement facilities refer to MIL-HDBK-1021/1, "AIRFIELD GEOMETRIC DESIGN".

1.3 Use flexible pavement for economy in construction cost and where portland cement concrete paving is not required. In those cases where either pavement type is acceptable and economically competitive, provide pavement designs for both types of pavement.

1.4 The design of pavements shall take into consideration the anticipated traffic over the life of the project (typically 20 years) and the soil conditions existing at the site. Many times traffic information is not available and the engineer will have to make some assumptions based on his own experience and information received from activity personnel.

1.5 Use portland cement concrete pavement in refueling and service areas where petroleum products regularly drip or leak on the pavement and would be detrimental to asphaltic pavement. Portland cement concrete pavement may also be required in areas where insitu soil conditions warrant its use due to poor bearing capacity. Use portland cement concrete pavement in motorcycle parking areas and in areas where tractor trailers are parked to better withstand point loads imposed by kickstands and stabilizing jacks. Use Portland cement concrete pavements where pavements will be subject to track driven military vehicles. Use Portland cement concrete pavements where pavement will be subject to impact loading, such as in and around trash enclosures.

1.6 The design of the pavement section shall take into consideration the potential for freeze and thaw conditions in the base course layer. When there is a potential for freeze and thaw occurring in the base, the base course shall be designed as a free draining base and shall extend into the subgrade to a depth equivalent to the depth of the freeze line. The swelling potential of soils with high plasticity indexes should also be considered. Stabilization of such soils with lime, cement, asphalt, fly ash or a combination thereof may be beneficial.

1.7 Generally, soils information required for pavement design is obtained through the use of shallow borings (typically 3.0 m (10 ft)). The soils report, as a minimum, should include boring locations, boring logs, unified soil classification for all soils encountered, grain size analysis (ASTM D422), plastic limit and plasticity index (ASTM D4318) and in place moisture content. The soils report should also indicate, depending on anticipated pavement type, the California Bearing Ratio (CBR) or the subgrade support value (K) of the subgrade soils.

1.8 The strength of base and subbase material, whether under asphalt or concrete pavement, shall be measured by its California Bearing Ratio (CBR) as determined by ASTM D1883.

1.9 Pavement markings and signage should be in accordance with Federal Highway Administration standards as given in "Rigid Sign Supports" and "Manual of Uniform Traffic Control Devices."

1.10 Pavement design calculations shall be included with the Basis of Design providing all pertinent information used in determining the required pavement section.

PART 2 - ASPHALT PAVEMENT SYSTEMS

2.1 For guidance in designing asphaltic pavement sections for roads, streets and parking lots refer to NAVFAC DM 5.4, "PAVEMENTS".

2.2 Flexible pavements shall be designed based on the anticipated traffic and the load carrying capacity of the insitu soils as determined by a 4-day laboratory soaked California Bearing Ratio (CBR) test (ASTM D1883).

2.3 In designing the pavement section, use anticipated in place CBR values for soils which may be degraded by remolding such as clays. Anticipated in place CBR values should also be used when dealing with silts, very fine sands, or other soils, which may become quick or spongy, by pumping, in high water content areas. Stabilizing existing material with lime, cement or bitumen should be considered when economically attractive. When insitu soils are improved by compaction or stabilization, use the CBR value that is anticipated upon completion of improvement for designing overlying asphalt pavements.

2.4 The following minimum asphalt thicknesses shall be adhered to:

Primary road	80 mm (3 in)
Secondary road	50 mm (2 in)
Parking areas	50 mm (2 in)
Driveways	40 mm (1.5 in)
Surface used by tracked vehicles	Use concrete pavement

2.5 Asphalt mixes for vehicular pavement shall have a minimum stability of 450 kg (1000 lbs) as determined by the "Marshall Method of Mix Design". In areas of heavy truck movements, consider specifying 815 kg (1800 lb) stability asphalt for more rut resistant pavement. Use the 75 blow compaction procedures for designing primary roads and streets. For secondary roads, streets, and parking areas, use the 50 blow procedure.

2.6 Maximum aggregate size for an asphalt mix shall be 1/2 the lift thickness. When this aggregate is subjected to the Los Angeles Abrasion test, the loss in material shall not exceed 40%.

2.7 Asphaltic surface courses shall be placed in maximum 50 mm (2 in) compacted lifts. Asphaltic binder and base course may be placed in maximum 100 mm (4 in) lifts provided all compaction requirements are met.

2.8 Typically, an 80 CBR base course material should be used beneath asphaltic pavements. However, for low volume secondary roads and parking lots, a minimum CBR value of 60 may be allowed.

2.9 Subbase courses underlie base courses and are generally constructed of material having a minimum CBR value of 30.

2.10 Prime coats shall be used between new base course material and asphaltic surface course.

2.11 Tack coats shall be placed between successive layers of asphaltic concrete.

2.12 The bitumen specified should be suitable for the climate in which you are working.

2.13 SPECIAL AIRFIELD PAVEMENT REQUIREMENTS:

2.13.1 For guidance in designing asphaltic pavement sections for airfield pavement refer to NAVFAC DM 21.3, "FLEXIBLE PAVEMENT DESIGN FOR AIRFIELDS".

2.13.2 Upon completion of base course construction, proof roll on center 7.5 m (25 ft) of taxiways and on center 30 m (100 ft) of runways by eight coverages of the proof roller. To all other paved areas, exclusive of runway overrun and blast protection areas, apply four coverages.

2.13.3 Base courses shall be constructed of 80 CBR material.

2.13.4 Asphaltic concrete for airfield pavements shall be designed to provide min. 815 kg (1800 lb) stability and shall be based on a 75 blow Marshall mix design.

2.13.5 The following minimum thicknesses for airfield pavements shall be adhered to:

GROSS LOAD	TIRE PRESSURE	MINIMUM THICKNESS
< 12 kips	all tire pressures	2" surface / 6" base
12 to 30 kips	less than 200 psi	2" surface / 6" base
	greater than 200 psi	4" surface / 8" base
> 30 kips	all tire pressures	4" surface / 8" base

2.13.6 The aggregate used in asphalt mixes, when subjected to the Los Angeles Abrasion test, shall show a loss not to exceed 40% for surface courses and not more than 50% for base course.

2.13.7 The coarse and fine aggregates used for airfield pavements should be crushed materials in order to assure high stability and performance. Mixes using river run gravel should not be used in surface courses.

PART 3 - PORTLAND CEMENT CONCRETE PAVEMENT SYSTEMS

3.1 For guidance in designing portland cement concrete pavement sections for roads, streets and parking lots refer to NAVFAC DM 5.4, "PAVEMENTS".

3.2 Design of the portland cement concrete pavement shall be based on the subgrade support value "K" of the subgrade. Estimated values of subgrade support values are acceptable if adequate subsoil investigations have been conducted. Do not use estimated values of subgrade support values exceeding 300, unless substantiated by field-bearing test results. Values in excess of 500 should not be used regardless of test results.

3.3 Unless special conditions warrant, portland cement concrete pavement sections should be designed based on using 28 day, 4.5 Mpa (650 psi) flexural strength concrete.

3.4 Concrete mix shall be designed as an air entrained concrete and shall have a maximum water cement ratio of 0.5. The amount of cement shall be as required to achieve the desired strength with the anticipated aggregate.

3.5 Typically, portland cement concrete pavement should be designed as unreinforced pavement. In areas where odd shaped slabs occur, i.e., length of slab exceeds width of slab by more than 25%, reinforcing shall be added to offset temperature related stresses. Clearly indicate those slabs that will require reinforcing on the drawings.

3.6 Joints shall be laid out in a uniform rectangular pattern to provide a typical 12.5' x 15' slab spacing. Typically, this means that paving lanes will be 25' wide with transverse joints placed on 15' centers.

3.7 Joints shall be designed to accommodate edge stresses built up as vehicles approach the joint. This is normally accomplished through thickening the edges for expansion joints and by load transfer in keyed construction joints and contraction joints. Clearly show and label all joints and provide typical details for all joints used.

3.8 New concrete pavement typically does not require any interior expansion joints due to the fact that at time of placement the concrete is at its largest volume and from that point shrinks. Place thickened edge expansion joints between new and existing pavement and where opposing runs of concrete meet. Use non thickened expansion joints in areas of no traffic such as between pavement and buildings.

3.9 Base courses under concrete pavement, shall have a minimum CBR value of 30.

3.10 Consult with the SOUTHWESTNAVFACENGCOM Senior Civil Engineer when pavements will be in contact with extreme degrees of soil alkalinity.

3.11 SPECIAL REQUIREMENTS FOR AIRFIELDS:

3.11.1 For guidance in designing portland cement concrete pavement sections for airfield pavement refer to MIL-HDBK-1021/4, "RIGID PAVEMENT DESIGN FOR AIRFIELDS".

3.11.2 The minimum design life for Navy and Marine Corps facilities is 20 years. Obtain data for the specific Navy and Marine Corps airfield facility under design to forecast aircraft traffic operations over the design life of the pavement. When site specific traffic projections are not available, the aircraft pass levels listed below are the minimum pass levels to be used in design.

Type	Pass Level
F-14	300,000
P-3	100,000
C-130	50,000
C-141	25,000

Type	Pass Level
C-5	25,000

3.11.3 Minimum thickness for utilization of keyed joints in airfield pavements is 9". Pavement sections of less than 9" must be constructed of butt joints on a stabilized base. The economics of going to a thicker pavement and deletion of stabilized base requirements should be considered.

3.11.4 Minimum aggregate base course thickness is 6". Actual thickness shall be as required to provide a minimum support value "K" of 200.

3.11.5 Design hangar floors for 60% of the maximum gross weight of the aircraft with a minimum floor thickness of 8".

END OF SECTION